

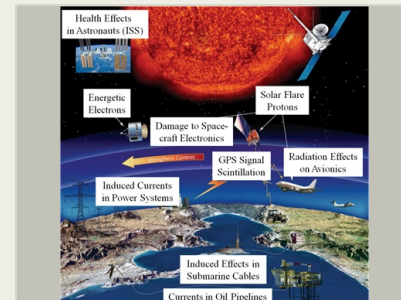
Improved Forecasting of Solar Particle Events and their Effects on Space Electronics, Phase I

Completed Technology Project (2015 - 2016)



Project Introduction

High-energy space radiation from Galactic Cosmic Rays and Solar Particle Events (SPEs) pose significant risks to equipment and astronaut health in NASA missions. In particular, energetic particles from SPEs associated with flares and coronal mass ejections (CMEs) constitute a highly dynamic and penetrating radiation environment that may adversely affect not only beyond-Low-Earth-Orbit missions, but also aircraft avionics, communications, and airline crew/passenger health. It is crucial to develop a capability to forecast SPEs and their effects on systems to guide planning of mission-related tasks and to adopt risk mitigation strategies for personnel and equipment. In this project, CFD Research Corporation (CFDRC) and the University of Alabama in Huntsville (UAH) propose to develop a comprehensive modeling capability - SPE Forecast (SPE4) - comprising state-of-the-art modules that individually address important aspects of the overall problem, integrated within a novel Python-language-based framework. SPE4 will include: (a) the MAG4 code for probability forecasts of flares/CMEs, and resulting SPEs, based on SDO/HMI magnetograms, interfaced to (b) the PATH code for transport of emitted particles through the heliosphere, interfaced to (c) Geant4-based transport calculations for particles through geomagnetic field modulation and atmospheric interactions (in low-Earth orbits), to finally yield spectra of SPE-induced energetic protons and heavy ions (and secondary particles) as a function of time and location. In Phase I, we will develop an SPE4 framework prototype, demonstrate automated execution and information flow between different codes, and validate against data for a known event. In Phase II, we will collaborate with Vanderbilt University to interface the resulting particle spectra with downstream codes to calculate single-event effects in electronics. The SPE4 framework, interfaces, and procedures will be optimized for rapid "event to effects" predictions.



Improved Forecasting of Solar Particle Events and their Effects on Space Electronics, Phase I Briefing Chart Image

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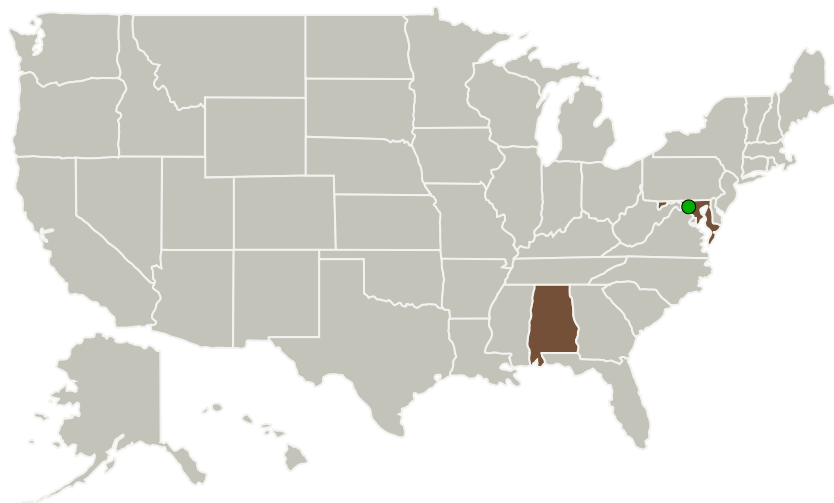
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
CFD Research Corporation	Lead Organization	Industry	Huntsville, Alabama
● Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland
University of Alabama in Huntsville(UAH)	Supporting Organization	Academia	Huntsville, Alabama

Primary U.S. Work Locations

Alabama	Maryland
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Project Transitions

▶ **June 2015:** Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

CFD Research Corporation

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

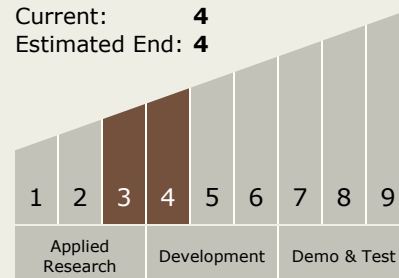
Carlos Torrez

Principal Investigator:

Ashok Raman

Technology Maturity (TRL)

Start: **3**
 Current: **4**
 Estimated End: **4**



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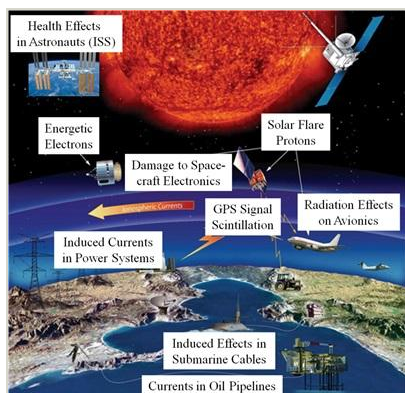


✓ **June 2016:** Closed out

Closeout Documentation:

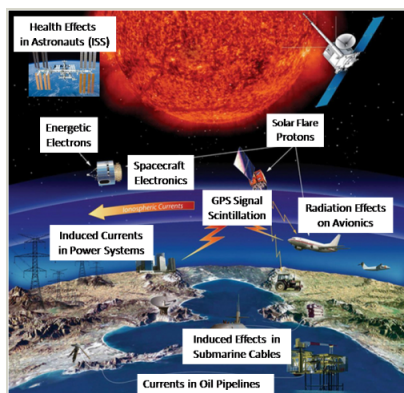
- Final Summary Chart(<https://techport.nasa.gov/file/138972>)

Images



Briefing Chart Image

Improved Forecasting of Solar Particle Events and their Effects on Space Electronics, Phase I Briefing Chart Image
(<https://techport.nasa.gov/image/129864>)



Final Summary Chart Image

Improved Forecasting of Solar Particle Events and their Effects on Space Electronics, Phase I Project Image
(<https://techport.nasa.gov/image/134739>)

Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
 - └ TX06.5 Radiation
 - └ TX06.5.4 Space Weather Prediction

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System